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Prospects for New Science using X-ray Photon Correlation Spectroscopy at an XFEL

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X-ray photon correlation spectroscopy (XPCS) is a technique used to measure the dynamics of condensed matter systems. When a sample is illuminated with a coherent X-ray beam a speckle pattern is superimposed on the X-ray scattering pattern. The rate of fluctuations in the speckle pattern at a particular wavevector can be used to determine the dynamics of the sample at the corresponding length scales. Because of the need for intense coherent beams, XPCS measurements have been limited to third-generation synchrotrons, and even at these facilities the range of accessible length and time scales is restricted. An XFEL would provide approximately a million times the coherent flux as present third-generation synchrotron sources. Flux of this magnitude will revolutionize the study of condensed matter dynamics with XPCS. Promising applications of XPCS with an XFEL will be discussed, along with the concomitant improvements that will be needed in optics and detectors to make such applications possible.